

has to be moved horizontally); then the sum total, which I call "convection-resistance" due to mixtures, presents an important factor in the turbulent motion of the atmosphere, and may be treated by methods that Boussinesq developed for the study of tumultuous river currents.

5. The reaction between the wind and the ocean by virtue of which surface waters are blown horizontally with a speed of perhaps 1 per cent of the general motion of the adjacent air, introduces a secondary term for the oceanic surface, which does not occur in the land surface, but this is comparatively a minor matter.

6. The superior quantity of latent heat contained in moist air is probably next in importance to the resistance offered by the irregularities of continental or other large masses of land, and its importance may be best evaluated by a study of the quantity of rain, snow, cloud, or fog. The formation of cloud or fog not only evolves latent heat, but entirely alters the coefficient of radiation or absorption of the atmosphere; cloudy air differs in these respects from clear air; the precipitation of rain or snow does even more than this, for it leaves a corresponding amount of latent heat free in the atmosphere, thereby permanently affecting its temperature, and the atmospheric temperature that our equations now have to deal with is that due on the one hand to insolation and its attendant absorption, conduction, and convection, and on the other hand to the latent heat left in the atmosphere by precipitation. The formation of cloud or fog as such, by virtue of the cooling due to expansion, does not materially affect the quantity of heat in the atmosphere. It produces only a temporary local phenomenon, since the expanding air is very soon brought under high pressure, compressed and warmed, before the latent heat, at first evolved, has had time to be lost by radiation or otherwise.

ORIGIN OF THE RARE GASES IN THE EARTH'S ATMOSPHERE.

In a report made by Dr. S. A. Mitchell on the spectroscopic work done by him during the solar eclipse of May 18, 1901, at

Sumatra, and published by Columbia University (New York City), there occur the following interesting paragraphs relative to the earth's atmosphere and the spectra of the aurora borealis:

Consequently, it seems that the more volatile gases of terrestrial atmospheric air uncondensed at the temperature of liquid hydrogen, together with hydrogen, helium, neon, and argon, are present in the solar chromosphere, while the evidence in regard to krypton and xenon is inconclusive.

The finding of these gases in the sun and the undoubted presence of free hydrogen in the earth's atmosphere have an importance for cosmical physics that can hardly be overestimated. According to Liveing and Dewar, "if the earth can not retain hydrogen or originate it, then there must be a continued accession of hydrogen to the atmosphere (from interstellar space), and we can hardly resist the conclusion that a similar transfer of other gases must also take place." (Proc. Roy. Soc., vol. 67, p. 468, 1900.) It has been shown by these distinguished physicists, and again by Dewar in his presidential address before the British Association for the Advancement of Science, that these new gases, and particularly the more volatile gases of atmospheric air, play an important part in the spectra of the aurora, of nebulae, and of the corona. "Of more than a hundred auroral rays observed by Stassano, more than two-thirds of them appear to belong to the more volatile gases of atmospheric air, while the majority of the remainder seem to belong to argon, krypton, and xenon." We are also told by Dewar that of a "list of 339 lines photographed by Humphreys during totality" [this, however, was called the spectrum of the corona, whereas it was the spectrum of the chromosphere] "only 55 do not differ by more than one unit on Angström's scale from lines measured in the most volatile gases of the atmosphere or in krypton or xenon. It seems rather to the present writer that the great majority of these lines more closely correspond to Fraunhofer lines than to the lines of these rare gases."

These gases may take their origin from the earth itself; in fact, helium and neon are occluded from the waters of the Bath Spring in England. The presence of free hydrogen in the atmosphere can not be explained in this way. It is more likely that hydrogen comes to us in small ionized particles from the sun, being sent hither, as has been shown by Arrhenius, by the pressure of light; and likewise helium and the more volatile gases are present in the atmosphere through being repulsed from the sun by the ionization of small particles of these gases.

It seems, therefore, that the finding of these new gases in the sun's chromosphere is an independent verification of the truth of the theory of Arrhenius, which tells us that particles of matter are being continually scattered throughout the universe, starting from one sun and reaching another, with the result that all bodies of the universe are gradually becoming more and more alike.

THE WEATHER OF THE MONTH.

By Mr. W. B. STOCKMAN, District Forecaster, in charge of Division of Meteorological Records.

PRESSURE.

The distribution of mean atmospheric pressure is graphically shown on Chart IV and the average values and departures from normal are shown in Tables I and VI.

The mean monthly pressure was high from Kentucky, Tennessee, and Georgia northwestward to the coast of the northern and central Pacific districts, and the northern portions of the southern Pacific, with the crest overlying the northern Plateau, and a second area of relatively high but considerably lower mean pressure over the interior of Louisiana, Mississippi, and Alabama. At Boise, Idaho, the mean monthly pressure was 30.40 inches.

The mean pressure was lowest over the northern upper and eastern lower Lakes, northern Middle Atlantic States, and New England, which was the only portion of the country where the mean pressure was below 30.00 inches. The lowest mean monthly barometer reading was 29.90 inches at Eastport, Me.

The mean pressure was below the normal from Minnesota, Iowa, northern Missouri, eastern Kentucky, eastern Tennessee, and northeastern Georgia eastward to the Atlantic Ocean; and above the normal in all other districts.

The greatest minus departures ranged from $-.05$ to $-.10$ inch, and occurred in New England, the northern part of the Middle Atlantic States, the lower Lake region, and the northeastern half of the upper Lake region.

Throughout the entire Plateau region the barometer was

.10 inch or more above the normal, maximum plus departures occurring over the middle Plateau, and the eastern portion of the north Pacific district, where they ranged from $+.20$ to $+.23$ inch.

The mean pressure decreased from that of November 1903, in the Lake regions, New England, Middle Atlantic States, northern portion of the South Atlantic States, eastern parts of the Ohio Valley and Tennessee, upper Mississippi Valley, Missouri Valley, North Dakota, and eastern Montana; and increased over the preceding month in the remaining portions of the United States. The greatest decreases occurred in the northern border States from Minnesota eastward, and were comparatively small, being less than .10 inch, while over the north Pacific, Plateau, and portions of the slope and middle Pacific regions the increase amounted to $+.10$ to $+.28$ inch, —the maximum occurring over the northern portions of the northern Plateau and north Pacific districts.

TEMPERATURE OF THE AIR.

The distribution of maximum, minimum, and average surface temperatures is graphically shown by the lines on Chart VI.

The mean temperature was below the normal from the west Gulf States, Missouri Valley, and central North Dakota eastward to the Atlantic Ocean, and in portions of the Plateau regions; and above the normal elsewhere. Over the region east of the Mississippi River the departures were very marked, and averaged from -4.0° to -10.1° per day, the maximum defi-